BELLCOMM, INC.

SUBJECT: Trip Report - Joint LRC/MSC Planning Session on Lunar Orbiter Mission B - Case 340

DATE: May 9, 1966

FROM: W. B. Thompson

ABSTRACT

A joint LRC/MSC meeting was held at MSC on April 18, 1966, to discuss the objectives of Lunar Orbiter Mission B. The USGS outlined sample sites for a mission based on an engineering geology strategy in which areas would be photographed to provide data on the engineering properties of the lunar surface of interest to Apollo. Such information would act as a backup to Surveyor.

MSC listed the constraints delineating the regions on the lunar surface accessible to Apollo, the desired topography at the site, and the lighting conditions at the time of LEM landing. These constraints will be re-examined in the next few weeks so that Lunar Orbiter mission planning can provide the optimum site survey for Apollo within the limits of the Orbiter capability.

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MEMORANDUM FOR FILE

On April 18, 1966, a joint LRC/MSC planning session devoted to Lunar Orbiter Mission B was held at MSC. The purpose of the meeting was to transmit Apollo constraints bearing on both the location and topographic conditions of LEM landing sites to the Lunar Orbiter mission planners in an effort to optimize the Lunar Orbiter Mission B site survey strategy.

The list of attendees included:

L. Reiffel - NASA/MA-6
A. T. Strickland - NASA/SL
N. L. Crabill - NASA/LRC
A. T.Young - NASA/LRC
J. E. Dornbach - MSC/ET33
J. R. Elk - MSC/FM5
W. P. LeCroix - MSC/ET33
J. P. Loftus - MSC/PS4
C. C. Mason - MSC/ET33
R. L. Nance - MSC/ET33
J. H. Sasser - MSC/ET33
L. C. Rowan - USGS
H. Masursky - USGS
H. Moore - USGS
D. Ahearne - TRW
D. B. James - Bellcomm
D. D. Lloyd - Bellcomm
W. B. Thompson - Bellcomm
R. L. Wagner - Bellcomm

Four possible strategies for Mission B were outlined by LRC. Briefly these were:

1. Sample multiple terrain types, as in Mission A.

2. Sample key geologic areas with the goal of determining as much as possible about the soil mechanics properties of the surface.

3. Fill in the Apollo zone to provide potential landing sites as many days of the month as possible.

4. Overfly a landed Surveyor.

The Engineering Geology Mission

LRC had previously asked the USGS to plan a sample mission to fit the second strategy listed above. This was termed an engineering geology mission.

Methods of obtaining engineering geology data, in order of decreasing confidence, were listed as follows:

1. Successful Surveyor.

2. Orbiter photographs of the landing site.

3. Orbiter photographs of an area removed from the potential landing site, implying the extrapolation of observed engineering properties back to the landing site.

The USGS suggestion for a Mission B plan based on the engineering geology strategy included sites in two general categories. Photographic coverage of a site would nominally be as in Mission A.

The first category (method 2, listed above) would include several sites located in the smoothest areas in the Mission A photos. These several sites would be rephotographed when they are 10° - 15° from the terminator as a final delineation of the topography. The low sun angle would also help expose any block material lying on the surface from which an estimate of surface bearing strength might be made. The observation of the nature of the rim material around a crater should serve as a measure of the soil cohesion, as earth-based impact crater experiments indicate that, in general, non-cohesive material (e.g., sand) forms a smooth rim while very cohesive material forms a blocky one. In addition, the observation of the angle of repose of the material at the crater walls may be used to estimate the cohesive properties.

The second category (method 3, listed above), which would use the remainder of the 10 possible sites per mission, would be devoted to photography of the so-called "key" geologic areas which would shed light on the engineering properties of the general area in which a candidate site was located. This general area may be hundreds of kilometers in diameter, in which case some extrapolation would be required from the key area to the candidate site. While this class of information was felt to be of lowest priority, it is nevertheless desirable to have in support of photos of the immediate site area.

The USGS has proposed a total of 21 sites to fit this category. The sites were grouped into six basic classes, as follows:

1. Volcanic domes
2. Linear and sinuous rilles
3. Single craters
4. Contact zones, as between maria and highlands
5. Chain craters
6. Miscellaneous (e.g., hummocky highlands)

In general, sites in this category may not be expected to contain topographically acceptable landing areas. However, the ability to observe key geologic areas which will provide greater insight as to the formative processes and general engineering properties at the remote and, by and large, featureless landing site may offset the handicap of having to extrapolate.

Apollo Constraints

Apollo constraints pertinent to selecting targets for Lunar Orbiter Mission B were restated in approximately the same form as when they were presented to the Apollo Site Selection Board on March 15, 1966.

1. An earth-based tracking constraint confines the LEM landing to remain within the longitudes 45° W and 43° E.
2. The "visual" slope which the LEM would encounter should be less than 6°. This figure may increase if the sinkage contribution to the effective slope decreases below what is currently anticipated.
3. For successful operation of the LEM landing radar the topography over the final 30 nm of the approach path should lie within a 4° wedge oriented normal to the plane of the surface with the landing site at the vertex and opening in the direction of the approaching LEM. This applies over a trapezoidal area 16,000 feet wide at the landing site and 8.6 nm wide at the point 30 nm down the approach path.

4. The sun elevation angle at the site at the time of LEM landing should be in the range 7° - 20°. MSC interprets this to mean a site spacing of 11° ± 2° for accessibility on consecutive days. Three consecutive launch days are desirable but four offer greater flexibility.

All of these constraints are being reworked within MSC. The LRC people stated that Apollo should provide a set of constraints it is willing to live with as soon as possible if it expects to influence Lunar Orbiter Mission B planning. Launch vehicle targeting for a given mission plan must begin nine weeks before the scheduled launch. A minor change in the location of one site may be made after launch. A major change in the location of all sites would demand a new nine week retargeting effort. Without a firm idea of Apollo's preferences for Mission B sites, LRC will plan a mission which meets the current version of the constraints as well as possible.

A meeting has been scheduled for May 6 at LRC by which time it is hoped Apollo will have a firm set of constraints and a Mission B plan can be proposed.

W. B. Thompson

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